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EXAMINER	
SINGH, DALZID E	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/087,022	SHPANTZER ET AL.	
	Examiner	Art Unit	
	Dalzid Singh	2633	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-67 and 75-87* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *46-67 and 75-84* is/are allowed.

6)☒ Claim(s) *1-4,6-9,11-13,41-45,85 and 86* is/are rejected.

7)☒ Claim(s) *5,10,14-40 and 87* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *26 January 2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of the restriction requirement in the reply filed on 09 May 2005 is acknowledged.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "the receiver is configured to digitally rotate digitized electrical signals representative of two orthogonal polarizations of each subchannel to compensate for PMD in said each subchannel" of claim 4 and "the transmitter further comprises a modulator calibration unit configured to receive at least one subchannel signal output by a data demodulator and output at least one control signal to said data demodulator" of claims 8 and 43, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for

consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 4, 8 and 43 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claim 4 recites, "the receiver is configured to digitally rotate digitized electrical signals representative of two orthogonal polarizations of each subchannel to compensate for PMD in said each subchannel" However, there is no structure or circuit diagram provided to teach a person of ordinary skill how to digitally rotate digitized electrical signals. Therefore, the specification fails to provide enabling disclosure for claim 4.

Claims 8 and 43 recites, "the transmitter further comprises a modulator calibration unit configured to receive at least one subchannel signal output by a data demodulator and output at least one control signal to said data demodulator". However, there is no structure or circuit diagram provided to teach a person of ordinary skill how to the modulator calibration unit configured to receive at least one subchannel signal output by a data demodulator and output at least one control signal to said data demodulator. Therefore, the specification fails to provide enabling disclosure for claims 8 and 42.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 41 and 43 are rejected under 35 U.S.C. 102(e) as being anticipated by Lo (US Patent No. 6,915,077).

Regarding claim 41, Lo discloses optical communication system, as shown in Fig. 1A) comprising:

at least one light source (10_1) arranged to output a number K subchannel light beams (λ_1- λ_N), each subchannel light beam being spaced apart from adjacent

subchannel light beams by a constant subchannel frequency spacing (since plurality of channels are generated, therefore the channels are separated by channels spacing in order to prevent interference between each channel;

K data modulators ($14_1 - 14_N$), each data modulator configured to modulate one of said subchannel light beams with data from a data stream to thereby form a subchannel signal, each data modulator including a polarization beam combiner which encodes data from said data stream on two orthogonal polarizations in said subchannel signal (see Fig. 5B and col. 8, lines 17-27); and

a combiner (16) configured to combine K subchannel signals to thereby form an optical channel signal.

Regarding claim 43 (as far as understood), as shown in Fig. 1A of Lo, the combination shows data modulator.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1-4, 6, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Watanabe (US Patent No. 5,896,211) and further in view of Layton (US Patent No. 5,212,825).

Regarding claim 1, Lo discloses optical communication system, as shown in Fig. 1A, comprising:

at least one transmitter (10_1) configured to receive a number K of data streams (L data channels) and transmit a frequency-division multiplexed optical channel signal (λ_1-λ_N) comprising a number K subchannels, each subchannel characterized by a subchannel frequency, fk, k=1, 2, . . . K; which is separated from adjacent subchannel frequencies by a constant subchannel frequency spacing, and each subchannel being modulated by one of the K data streams (since plurality of channels are generated, therefore the channels are separated by channels spacing in order to prevent interference between each channel);

the K subchannel frequencies are orthogonal to one another (the polarization modulator produces orthogonal polarization states); and,

at least one receiver (any one of element 22_1, 24_1 and 26_1 can be considered as receiver) optically connected to the at least one transmitter and configured to receive said frequency-division multiplexed optical channel signal, detect and demodulate said k subchannels within the frequency-division multiplexed optical channel signal.

Lo discloses receiver to receive the multiplexed optical signal and further indicates that the receiver can be implemented by a local optical source using homodyne or heterodyne techniques) and differ from the claimed invention in that Lo does not specifically disclose the receiver discriminates among the subchannels by mixing the channel signal with a subchannel light beam from a local subchannel light source, the subchannel light beam having subchannel frequency, to thereby form a

mixed optical signal. However, it is well known to provide local light source in heterodyne receiver system. As shown in Fig. 16, Watanabe shows mixing the channel signal with subchannel light (Lo-LD1) from a local light source to form a mixed optical signal. Therefore, it would have been obvious to an artisan of rodinary skill in the art at the time the invention was made to provide such receivers as taught by Watanabe to the receiver of Lo. One of ordinary skill in the art would have been motivated to do such in order to provide coherent detection.

Furthermore, the combination of Lo and Watanabe differs from the claimed invention in that the combination does not disclose integrating the mixed signal for a single symbol period. However, in communication system it is well know to integrated mixed signal. Layton is cited to show such well known concept. As shown in Fig. 1, Layton shows integrating of mixed signals. Therefore, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to provide such circuitry to integrate mixed signal. One of ordinary skill in the art would have been motivated to do such in order to detect variation between the signal levels.

Regarding claim 2, as disclosed above, the combination discloses that each subchannel modulated by one of the k data streams includes two orthogonal polarizations (Lo discloses that the polarization modulator is capable of producing various polarization states).

Regarding claim 3, as disclose by the combination it would have been obvious that the receiver is capable of compensating for polarization mode dispersion (PMD).

Regarding claim 4 (as far as understood), as discussed above, the combination discloses polarization demodulator at the receiver.

Regarding claim 6, the combination disclose that the transmitter (see Fig. 1A of Lo) comprises:

at least one light source (10_1) arranged to output K subchannel light beams, each subchannel light beam being spaced apart from adjacent subchannel light beams by a constant subchannel frequency spacing (it would have been obvious that the channels are separated by channels spacing in order to prevent interference between each channel;

K data modulators ($14_1 - 14_N$), each data modulator configured to modulate one of said subchannel light beams with data from one of said K data streams to thereby form a subchannel signal; and

a combiner (16) configured to combine K subchannel signals to thereby form an optical channel signal.

Regarding claim 8 (as far as understood), as shown in Fig. 1A of Lo, the combination shows data modulator.

Regarding claim 9, the combination discloses that the data modulators each include a polarization beam combiner which encodes data from said data stream on two orthogonal polarizations in said subchannel signal (see col. 8, lines 17-27 of Lo).

9. Claims 7 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Watanabe (US Patent No. 5,896,211) in view of

Layton (US Patent No. 5,212,825) and further in view of Von Helmolt et al (US Patent No. 6,008,931).

Regarding claim 7, as discussed above, the combination discloses optical source for producing plurality of light beams and differs from the claimed invention in that the combination does not disclose a frequency calibrator circuit receiving, as input, K subchannel light beams, and outputting at least one control signal to said at least one light source, the frequency calibrator circuit configured to maintain a frequency spacing between adjacent subchannel light beams. However, adjusting spacing between channels is well known. Von Helmolt et al is cited to show such well known concept. In col. 2, lines 11-27, Von Helmolt et al discloses adjusting of channel spacing of the transmitter. Therefore it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to provide such control system as taught by Von Helmolt et al to the optical transmitter of the combination in order to adjust channel spacing of the signals. One of rodinary skill in the art would have been motivated to do such in order to avoid interference between channels.

Regarding claim 11, as discussed above, the combination discloses optical source for producing plurality of light beams and differs from the claimed invention in that the combination does not disclose that the at least one light source comprises a single frequency comb generator configured to output the K subchannel light beams. However, providing frequency comb generator in communication system is well known. Von Helmolt et al is cited to show such well known concept. In col. 2, lines 11-27, Von Helmolt et al discloses frequency comb generator. Therefore, it would have been

obvious to an artisan of ordinary skill in the art at the time the invention was made to provide frequency comb generator as taught by Von Helmolt et al to the communication system of the combination. One of ordinary skill in the art would have been motivated to do such in order to generate plurality of signal using a single source instead of plurality of sources and hence reduce system cost.

10. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Watanabe (US Patent No. 5,896,211) in view of Layton (US Patent No. 5,212,825) in view of Von Helmolt et al (US Patent No. 6,008,931) and further in view of Lyon et al (US Patent No. 5,838,727).

Regarding claim 12, as discussed above, the combination discloses transmission of optical signal and differs from the claimed invention in that the combination does not disclose that the transmitter further comprises a pulse shaper circuit configured to shape at least one of the subchannel light beams prior to modulation by the data modulator. However, shaping the optical signal prior to modulation is well known. Lyon et al is cited to show such well known concept. In col. 2, lines 33-35, Lyon et al teach pulse shaping prior to modulating the carrier signal. Therefore, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to shape the pulse signal prior to modulation. It is generally known that optical sources and transmission line generates noise, therefore one of ordinary skill in the art would have been motivated to shape pulse signal prior to modulation in order to reduce noise.

11. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Watanabe (US Patent No. 5,896,211) in view of Layton (US Patent No. 5,212,825) and further in view of Lyon et al (US Patent No. 5,838,727).

Regarding claim 13, as discussed above, the combination discloses transmission of optical signal and differs from the claimed invention in that the combination does not disclose that the transmitter further comprises a pulse shaper circuit configured to shape at least one of the subchannel light beams prior to modulation by the data modulator. However, shaping the optical signal prior to modulation is well known. Lyon et al is cited to show such well known concept. In col. 2, lines 33-35, Lyon et al teach pulse shaping prior to modulating the carrier signal. Therefore, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to shape the pulse signal prior to modulation. It is generally known that optical sources and transmission line generates noise, therefore one of ordinary skill in the art would have been motivated to shape pulse signal prior to modulation in order to reduce noise.

12. Claims 42 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Von Helmolt et al (US Patent No. 6,008,931).

Regarding claims 42 and 44, as discussed above, Lo discloses optical source for producing plurality of light beams and differs from the claimed invention in that the combination does not disclose a frequency calibrator circuit receiving, as input, K subchannel light beams, and outputting at least one control signal to said at least one

light source, the frequency calibrator circuit configured to maintain a frequency spacing between adjacent subchannel light beams. However, adjusting spacing between channels is well known. Von Helmolt et al is cited to show such well known concept. In col. 2, lines 11-27, Von Helmolt et al discloses adjusting of channel spacing of the transmitter. Therefore it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to provide such control system as taught by Von Helmolt et al to the optical transmitter of Lo in order to adjust channel spacing of the signals. One of rodinary skill in the art would have been motivated to do such in order to avoid interference between channels.

13. Claim 45 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Lyon et al (US Patent No. 5,838,727).

Regarding claim 45, as discussed above, the combination discloses transmission of optical signal and differs from the claimed invention in that the combination does not disclose that the transmitter further comprises a pulse shaper circuit configured to shape at least one of the subchannel light beams prior to modulation by the data modulator. However, shaping the optical signal prior to modulation is well known. Lyon et al is cited to show such well known concept. In col. 2, lines 33-35, Lyon et al teach pulse shaping prior to modulating the carrier signal. Therefore, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to shape the pulse signal prior to modulation. It is generally known that optical sources

and transmission line generates noise, therefore one of ordinary skill in the art would have been motivated to shape pulse signal prior to modulation in order to reduce noise.

14. Claims 85 and 86 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lo (US Patent No. 6,915,077) in view of Aso et al (US Patent No. 5,965,874).

Regarding claim 85, Lo discloses optical communication system comprising of polarization demodulator which include Stokes estimator (see Fig. 5C and col. 8, lines 28-34). Lo differs from the claimed invention in that Lo does not specifically disclose the following step of:

(a) separating the optical signal into a first digital signal having a first polarization and a second digital signal having a second polarization;

(b) calculating a Stokes-parameter based discriminator function based on the first and second digital signals; and

(c) estimating a timing error signal from the Stokes-parameter based discriminator function.

However, in optical communication system it is well known to calculate Stokes parameter based on the polarization of the signal. Aso et al is cited to show such well known concept. In col. 11, lines 66-67 to col. 12, lines 1-18, col. 31, lines 1-55 and col. 32, lines 60-65, Aso et al disclose calculation of Stokes parameter based on the polarization of the optical signal and generating error signal. Therefore, it would have been obvious to an artisan of ordinary skill in the art at the time the invention was made to provide Stokes calculation based on the polarization of the optical signal as taught by

Aso et al to the optical communication system of Lo. One of ordinary skill in the art would have been motivated to do such in order to compensate for polarization mode dispersion.

Regarding claim 86, as discussed above, the discriminator function is formed from an inner product of Stokes vectors derived from the first and second digital signals (see col. 11, lines 66-67 to col. 12, lines 1-18, col. 31, lines 1-55 and col. 32, lines 60-65 of Aso et al).

Allowable Subject Matter

15. Claims 46-67 and 75-84 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Claim 46 is allowed because the prior arts of record do not teach or suggest optical communication system comprising:

K subchannel receivers, the subchannel receiver comprising optical and digital circuitry configured to receive the identical received channel signals and a reference light beam having a subchannel frequency and output a first digital signal representative of in-phase and quadrature components of a first orthogonal polarization component associated with the subchannel frequency, and also output a second digital signal representative of in-phase and quadrature components of a second orthogonal polarization component associated with the subchannel frequency, the first and second digital signals containing information representative of a data stream used to modulate

the subchannel frequency; and a receiver processor configured to receive said first and second digital signals and output said data stream.

Claim 75 is allowed because the prior arts of record do not teach or suggest optical communication system comprising:

a frequency calibration system for calibrating a number K of laser light beams, each laser light beam having a frequency fk, k=1, 2, 3, . . . , K, the frequency calibration system comprising:

an optical switch system configured to select one from among the K laser light beams and a reference beam and output a selected beam;

a splitter disposed to receive the selected beam and output first identical first and second selected beams;

an optical detector configured to receive a delayed version of the first selected beam and the second selected beam, and output at least one electrical signal proportional to a phase difference between the two beams;

a controller configured to receive said at least one electrical signal and output at least one frequency calibration control signal to control at least one light source responsible for creating at least one of said plurality of laser light beams.

Claim 78 is allowed because the prior arts of record do not teach or suggest optical communication system comprising:

an iterative method for compensating for polarization mode dispersion (PMD) in an optical signal comprising:

(a) determining a candidate pair of rotation angles for adjusting a state of polarization of the optical signal;

(b) calculating at least one metric for said candidate pair of rotation angles (c) storing the at least one metric and also outputting at least one PMD device control signal that is applied to a PMD compensator device into which the optical signal is input;

(d) repeating steps (a), (b) and (c) until metrics for a predetermined set of candidate pairs have been calculated;

(e) finding the optimum metric and the optimum rotation angles corresponding to that metric; and

(f) outputting at least one PMD device control signal which corresponds to the optimum angles, to said PMD compensator device into which the optical signal is input.

Claim 81 is allowed because the prior arts of record do not teach or suggest optical communication system comprising:

a method for compensating for polarization mode dispersion (PMD) in an optical signal having two orthogonal polarizations, the method comprising:

(a) determining a candidate pair of rotation angles for adjusting a state of polarization of the optical signal;

(b) calculating at least one metric for said candidate pair of rotation angles; (c) storing the metric;

(d) performing steps (a), (b) and (c) until metrics for a predetermined set of candidate pairs have been calculated;

(e) finding the optimum metric and the optimum rotation angles corresponding to that metric, and then updating a rotation matrix having coefficients derived from the optimum rotation angles;

(f) digitally compensating for PMD by applying the rotation matrix to digitized signals representing the information set on the two orthogonal polarizations.

16. Claims 5, 10, 14-40 and 87 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Otsuka et al (US Patent No. 5,841,557) is cited to show polarization scrambling forming WDM signal light.

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dalzid Singh whose telephone number is (571) 272-3029. The examiner can normally be reached on Mon-Fri 9am - 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jason Chan can be reached on (571) 272--3022. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DS
July 23, 2005
David Singh